



INVESTIGATOR'S ANNUAL REPORT

United States Department of the Interior
National Park Service

All or some of the information you provide may become available to the public.

OMB # (1024-0236)
Exp. Date (11/30/2010)
Form No. (10-226)

Reporting Year: 2009	Park: Shenandoah NP	Select the type of permit this report addresses: Scientific Study	
Name of principal investigator or responsible official: Frank Panek		Office Phone: 304-724-4431	
Mailing address: USGS/Leetown Science Center National Fish Health Research Laboratory 11649 Leetown Road Kearneysville, WV 25428 USA		Office FAX 304-724-4435 Office Email fpanek@usgs.gov	
Additional investigators or key field assistants (first name, last name, office phone, office email)			
Name: Steve Reeser		Phone: 540-248-9360	Email: steve.reeser@dgif.virginia.gov
Name: Don Kain		Phone: 540-574-7815	Email: dgkain@deq.virginia.gov
Name: Anne Henderson		Phone: 304-724-4452	Email: ahenderson@usgs.gov
Name: Rocco Cipriano		Phone: 304/724-4432	Email: rcipriano@usgs.gov
Project Title (maximum 300 characters): Evaluating possible reservoirs of Aeromonas salmonicida in the South Fork of the Shenandoah River: Salmonid and coldwater influences.			
Park-assigned Study or Activity #: SHEN-00361	Park-assigned Permit #: SHEN-2009-SCI-0005	Permit Start Date: Mar 11, 2009	Permit Expiration Date: Sep 30, 2009
Scientific Study Starting Date: Mar 11, 2009		Estimated Scientific Study Ending Date: Sep 30, 2009	
For either a Scientific Study or a Science Education Activity, the status is: Completed		For a Scientific Study that is completed, please check each of the following that applies: <input checked="" type="checkbox"/> A final report has been provided to the park or will be provided to the park within the next two years <input type="checkbox"/> Copies of field notes, data files, photos, or other study records, as agreed, have been provided to the park <input type="checkbox"/> All collected and retained specimens have been cataloged into the NPS catalog system and NPS has processed loan agreements as needed	
Activity Type: Research			
Subject/Discipline: Fish / Ichthyology			

Purpose of Scientific Study or Science Education Activity during the reporting year (maximum 4000 characters):

The Virginia Department of Environmental Quality and the Department of Game and Inland Fisheries, along with their partners on the Shenandoah River Fish Kill Task Force (including the USGS), have researched putative causes of the fish kills that have occurred in the Shenandoah River watershed since 2004. The Shenandoah River has been one of the best smallmouth bass fisheries in the United States, but an estimated 80% of the adult smallmouth bass and redbreast sunfish were lost in 2004-2005. About 75 miles of the

North Fork Shenandoah River were impacted in 2004 and 100+ miles of the South Fork and mainstem Shenandoah were affected in 2005. Adult smallmouth bass and redbreast sunfish exhibited bacterial lesions that resulted in mortality, following the first major precipitation/runoff event in the spring.

There has been much discussion to determine whether or not *Aeromonas salmonicida* may be a primary pathogen of these fish. As the summer progressed, water temperatures increased, mortality subsided, and it was also observed that some of the lesions on affected fish began to heal. *Aeromonas salmonicida* is considered a cold or, at best, a cool water pathogen and, therefore, it is not surprising that the warmwater temperatures of the summer were not conducive to additional lesion development and mortalities induced by *A. salmonicida*. It is even questionable if the bacterium survived in the rivers during the summer because water temperatures were indeed close to its lethal limit. This poses a significant question and one that has great management implications. Can *A. salmonicida* survive the summer temperatures of the Shenandoah and James Rivers and establish asymptomatic carrier states in smallmouth bass or other native fishes?

There remains the need to identify if *A. salmonicida* is the primary cause of the lesions and mortalities in fish kills in the South Fork of the Shenandoah River, and in other rivers such as the Cowpasture, Jackson, and upper James Rivers. Although the data presented thus far does indeed indicate that this pathogen was indeed a causative agent of the spring 2007 and 2008 lesions and mortalities, the data are only pertinent to those particular years.

Only additional sampling will be able to evaluate the persistence of *A. salmonicida* as a putative agent for the extended fish kills. To further evaluate and confirm the etiology of infections in the Shenandoah, James, Jackson, and Cowpasture Rivers, the following studies are proposed. These studies are essential to confirm bacterial etiology by 1, Fulfilling Koch's postulates; 2, determining if contagion is affected by fish-to-fish contact or broad dispersion in the environment; and 3, evaluating innate and acquired resistance of riverine fishes to infection.

Findings and status of Scientific Study or accomplishments of Science Education Activity during the reporting year (maximum 4000 characters):

Smallmouth bass from the Maury River (an unaffected river) were used in experimental challenges to fulfill Koch's postulates. In these studies, Atlantic salmon were injected with *A. salmonicida* obtained from either the Shenandoah or James Rivers and cohabited with an equal number of specific pathogen-free smallmouth bass from the Maury River. The smallmouth bass were divided into three groups: (1) scarified by removal of several scales along the left lateral line to establish a percutaneous route of bacterial invasion, (2) had a small gill snip to establish a perbranchial route of entry, (3) or left alone without any additional stress. Each group was then cohabited with the injected Atlantic salmon. The salmon died within 3-5 days post injection and in each case *A. salmonicida* was transmitted to the smallmouth bass at approximately 10 days post cohabitation at 12.5oC. Lesion development and mortality was observed in all groups and *A. salmonicida* was re-isolated from the lesions and kidneys of the experimental smallmouth bass fulfilling Koch's postulates.

In addition to these studies, additional field work was established to determine where reservoir of infections may exist in the natural environment. Evidence collected to date suggests that stocked salmonids in coldwater headwater streams or residing in spring seeps within the Shenandoah River may be acting as reservoirs of infection. This hypothesis will be further examined in FY2010 in waters outside of Shenandoah National Park.

For Scientific Studies (not Science Education Activities), were any specimens collected and removed from the park but not destroyed during analysis?

No

Funding specifically used in this park this reporting year that was provided by NPS (enter dollar amount):
\$0

Funding specifically used in this park this reporting year that was provided by all other sources (enter dollar amount):
\$17000

List any other U.S. Government Agencies supporting this study or activity and the funding each provided this reporting year:

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